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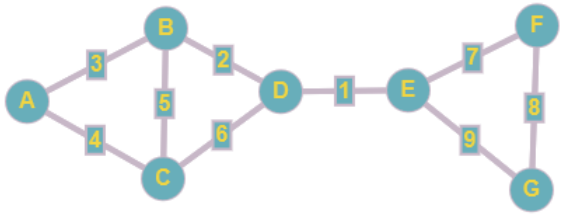
CSCI 3104, Algorithms **Profs. Chen & Grochow**

Quiz 7 Q1 S12 **Spring 2020, CU-Boulder**

Instructions: This quiz is open book and open note. You **may** post clarification questions to Piazza, with the understanding that you may not receive an answer in time and posting does count towards your time limit (30 min for 1x, 37.5 min for 1.5x, 45 min for 2x). Questions posted to Piazza **must be posted as PRIVATE QUESTIONS.** Other use of the internet, including searching for answers or posting to sites like Chegg, is strictly prohibited. Violations of these grounds to receive a 0 on this quiz. Proofs should be written in **complete sentences. Show and justify all work to receive full credit.**

Standard 12. Consider the following graph G.



(a) Determine all the edges of G which do not belong to any MST. Clearly justify your answer.

If there is a cycle in a graph, then the edge in that cycle that has the largest value cannot be in the MST.
Edge (C, D) is not in any MST because it is the largest value of the cycle (B, C, D).
Edge (C, B) is not in any MST because it is the largest value of the cycle (A, B, C).
Edge (E, G) is not in any MST because it is the largest value of the cycle (E, F, G).

(b) Determine all edges of G which belong to every MST. Clearly justify your answer.

Considering the answer to question (a), every other edge must belong to every MST because otherwise we would not be able to reach every vertex.
Those edges are:
(A, B)
(A, C)
(B, D)
(D, E)
(E, F)
(F, G)

We can see an example of such MST by running Kruskal's algorithm on all the edges other than the ones we removed in (a). When running Kruskal's algorithm, we will get all the edges listed above. Even if we included the removed edges from (a), Kruskal's would still not choose those edges because they would be considered unsafe.